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McKillop Library Electricity Use, Impacts and Solutions

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Abstract

A few weeks ago, our class went on a guided tour of the library, which taught us about what goes on in the library, how resources are used, and basically how the library operates. From our tour, we saw many problem areas that could use improvements. One of these areas is the library's use of electricity. Our group focused on the computers, printers, copiers, lights, and elevators in the library and how the library could use their electricity more efficiently. We have found that the library is not always using electricity effectively and efficiently. There are lights on when nobody is around and there are computers on when students are not using them. Our group examined the library's electric bill and the electronics that are using up this energy and money. We have discovered that the Library could have the most immediate and far-reaching reduction of greenhouse gas emissions by switching their electricity to GreenStart electricity. We have also found the library could save money and energy by turning electronics off or using power saving options when available.

Introduction

Environmental problems are a huge issue in our world today. All of the citizens of the world are faced with persistent environmental obstacles, such as, dirty water, a decreased food supply, air pollution, energy resources, climate change, among many other concerns (Cunningham and Cunningham 5; Brown). Americans use our earth's resources at a rate that is impossible to maintain without the possibility of damaging the environment and harming future generations by leaving them with nothing. In order to be more "environmentally-friendly" and have a building that is more sustainable, the McKillop Library at Salve Regina University in Newport, Rhode Island, asked our science class to investigate how they use resources, see if it is sustainable, and if it is not, provide alternatives in order to run a building that will not be wasteful or harmful to the environment.

Our group focused on the electricity component of this project and the first step in tackling this task was to examine the electric bill. From January 2008 to January 2009 the library used 1134.51 megawatts of

energy (National Grid electric Bill). During this time the primary sources of electricity were Natural Gas (33.2%), Nuclear (28.2%) and Coal (12.3%). Because of the sources of electricity and the 1135 megawatts of consumption the library was responsible for emitting 965.47 pounds of carbon dioxide and 787.35 pounds of nitrogen oxides into the atmosphere (New England GreenStart—Rhode Island Disclosure Label). This energy use costs the library almost $2,500 per month (December 1, 2008—January 2, 2009 via most recent National Grid bill). To lower the impact through the user's electricity use, the National Grid offers a template that a facility can fill out to receive rebates on by ways of switching to more efficient lighting (NationalGrid.com).

Electricity comes with environmental impacts that are associated with the source of the electricity. Each consumer can choose what kind of "mix" to get their energy from to supply electricity for any building. For example, most providers offer coal powered electricity, the dirtiest source of power. "Every year coal-fired power plants release about 3.5 million tons of smog-forming nitrogen oxide, 10 million tons of sulfur dioxide, 48 tons of mercury, 56 tons of arsenic, 134,000 tons of hydrochloric acid and 130 million tons of toxic-laden waste -- some of it right into our air, ground and water supply" ("The Facts"). One of the ways our library can change their impact on the environment and make the building healthier for the environment is by switching their sources of electricity to ones that are more sustainable and healthier for the environment.

A shocking fact that our group noticed while touring the library was the seemingly wasteful electrical use. Lights were on everywhere, even where students and staff were not. It is not just that they are on where no one happens to be at that time, but in computer labs where no one is working or is scheduled to be working all day long. There were lights turned on during the day fully illuminating parts of the library that are not in frequent use, like the archives, and also remain bright around windows. This wasteful use was the same with the computers. There were numerous computers on when no students were using them. The elevator use seemed to also be very wasteful. Many students use the elevators not out of necessity, but out of laziness. We investigated all these issues during the course of the semester, gathered data, brought together our results, and put together recommendations for the library.

COMPUTERS/PRINTERS/COPIERS

Methods

The energy use of computers in McKillop Library seems have an easy fix: shut off computers when they are not in use. This is an easy assumption, but what we looked for in this project is concrete facts, evidence and results. Our specific focus in our Electricity group was the impact of the computers, printers, and copiers in the Library. Our research is focused on determining what portion of the electricity bill is taken up by these appliances. To determine how much energy is used, we plugged a *Kill-A-Watt* into the printers, copiers, and computers. We left in the Kill-A-Watt for a period of 24 hours, and it told the KW/hr usage of the appliance. This methodology did not give us *exact* results of the energy impact. For starters, it was nearly impossible to measure the KW/hr of every computer, printer, and scanner, so what we are working on here is averages and assumptions. In addition, we are only seeing the energy impacts over the course of the day, and use of these appliances varies from day to day. However, the figures from the Kill-A-Watt will give us a ballpark estimate on how much energy these appliances use.

Results

Our first task dealing with computers, printers, and copiers was to find out how many of these electronics are in the library. The chart below reveals these numbers. However, the true total number is slightly more than what we have listed here. There are some rooms in the library that were locked or that we were not allowed into, so our figures are not *completely* accurate, but they do come very close.

	Computers	Printers	Copiers
Library - 1st floor	66	15	3
Library - 2nd floor	19	4	1
Library - 3rd floor	13	2	1
Basement Level	145	4	0
Academic Development Center	5	1	0
Mailroom	3	0	2
Copy Center	3	1	2
TOTAL	**254**	**27**	**9**

Our next step was to calculate how much energy each electronic uses. The results are in the chart below.

Type	Floor	Placement	kw/H	kw/day	kw/ Year	Mw/ year
Computer	1	Left Side, backside, 6th computer	0.47	11.28	2526.72	2.52672
Computer	2	Right Side	0.42	10.08	2257.92	2.25792
Computer	2	Right Side	0.68	12.24	2741.76	2.74176
Computer	2	Left Side	0.13	3.12	698.88	0.69888
Computer	Basement	Lab 005	0.18	4.32	1576.8	1.5768
Mac Computer	Basement	Lab 006, Back row	1.44	34.76	7786.24	7.78624
Copier	2	Right Side	0.24	5.76	1290.242	1.290242
Printer	2	Right Side	0.8	19.2	4300	4.3
Printer	3	Right Side	0.1	2.4	537.6	0.5376
Card Swipe	3	Part of Printer Complex, Right Side	0.1	2.4	537.6	0.5376
Printer Complex	1	Right Side	0.24	5.76	1290.24	1.29024
Scanner	2	Left Side	4.7	112.8	25267.2	25.2672

Type (Avg of machines)	Mw/ year per Machine	Mw/ year for all Machines	% of Library Mw Usage	Total
Computer	2.931	744.474	65.6%	81.39%
Printers	2.222	59.99	5.29%	
Copier/Scanners	13.279	119.5	10.5%	

We discovered that all Mac computers remain on all the time. If a computer is turned off, it is automatically set to turn back on at 5 AM. The power settings were decided upon with UCL and Library Staff and are different depending on where the computers are located. Sleep mode has been disabled for library machines. They reboot once at 2 a.m. for maintenance, but are otherwise always running. The computers in the labs and teachers stations are set to shut off after maintenance at 2 a.m. every morning. As part of recent library policy, work study students are instructed to shut off all computers as part of their closing procedures. However, there are several factors that may prevent computers from being shut down. Some of these factors include the student being absent due to sickness or some other reason, such as the library being very busy near closing and students do not have enough time to shut them all down, or the might be technical problems. So basically, the computers are on all the time, twenty-four hours, seven days a week. Students are encouraged to just log off and not to shut down the computers. Computers are in constant use and to shut them off each time would not be practical. Additionally, computers that are frequently power

cycled often have more problems over its lifespan than those that remain powered on for extended periods. Computers use a lot more power in order to power up than they do during an hour being idle. This may be true, but overnight when the library is closed, the computers are idled for much longer than one hour. So the library really needs to look at that and really consider changing policy so that computers are shut off at night.

Discussion

Computers take up a huge portion of the electricity used by the McKillop Library. Through our research and during our presentation to the library staff, we learned that the library really only deals with the first, second, and third floors of the library, and that the basement level of the library is a completely different department. We discovered that the majority of the computers are located in the basement level of the library. These computers are also the ones that are used the least, but left on constantly. This is a real problem. It might be difficult, but we definitely recommend communication with the basement level staff and sharing with them our findings. Hopefully they will make a real effort to shut off computers as much as possible, especially overnight. As for the library, we recommend looking into different power settings for the computers, perhaps bringing back sleep mode. The library staff could also shut off printers and copiers overnight. We found that many devices are left on when nobody is using them. This is a great waste of electricity, a waste of money, and a real drain on the environment.

ELEVATOR

Methods

There are two elevators in the library, the private staff elevator and the elevator for public use. Our method was to see how often the elevators are used, if this use is absolutely necessary, and determine how much energy is being used by the elevators. I sat in the library by the elevator and counted how many times it went up and down. I also took a look at who was using the elevator and for what reason. To find out how much energy the elevator uses, I researched elevators and calculated how much energy the McKillop Library's elevators use by using these numbers.

Results

It takes approximately 4 Wh of energy for the elevator to run up one floor and 8 Wh of energy to go round trip. We observed the elevator use and the results are in the charts below. Projected over the course of the hours that the library is open, approximately 800 Wh of energy would be used per day. After surveying the elevator the week of March 2nd to March 4th, it appears that the elevator is being used mostly in the early afternoon when most of the students are on campus. The way I surveyed the elevators were by simply standing outside the elevator with my clipboard and when a student was going to use the elevator I would ask them which floor they were going to and I recorded my data accordingly. As the day progresses, the use of the elevator appeared to decline. Between 11 am – 2:30 pm was the busiest the elevator was during the whole day, as it had gotten used 14 times. Some students were using it out laziness, but some seemed like they had a legitimate reason to use the elevator.

Student Elevator Use

Date	Time	Duration	Est. Trips/hr	Est. Energy Cost
2-Mar	11:00 am - 2:30 pm	3.5 hours	4	96 Wh
3-Mar	2:00 pm - 3:30 pm	1.5 hours	3	40 Wh
4-Mar	9:00 pm - 10:30 pm	1.5 hours	2	32 Wh

Staff Elevator Use

Date	Time	Duration	Est. Trips.hr	Est. Energy Cost
2-Mar	11:00 am - 1:00 pm	2 hours	4	20 Wh
3-Mar	1:00 pm - 2:00 pm	1 hour	3	12 Wh
4-Mar	3:00 pm - 5:00 pm	2 hours	2	8 Wh

Discussion

Taking the stairs is very beneficial. Even though the elevator realistically does not use a great amount of energy, it is still a lot better for your health if you take the stairs instead of using the elevator. The energy does eventually add up if the elevator is used a lot. A policy of only allowing handicapped or disabled students to use the elevator would be very beneficial. A lot of students seem to be using the elevator even though they are perfectly capable of using the stairs. If McKillop Library installed a swipe card machine next to the elevator that students could swipe their ID in which would permit them access to the elevator, this would dramatically cut down use of the elevator. To get a pass for the elevator, the University would have to grant them access to one. The Library should put up signs that encourage use of the stairs. If there are signs

put up in the library that discourage use of the elevator and encourage use of the stairs, this may be another way reduce energy.

LIGHTING

Methods

As you can see from the Lux Chart provided below, you will notice the ranging differences between the values away from the window and by the window. To provide the reader with these results, Nellie and Marisa used a Kalibrier-Protokoll Testo 540 Light Intensity Meter (hereafter: lux meter) to the library. What the lux meter does is it senses the amount of lumens of light (lux = lumens per square meter) that are being emitted off of the lights in the room. As you got closer and closer to the window, the lux values rise, and as you go closer to the center of the room or where the sun is not shining the values decrease. In England, the law permits that 500lx is sufficient lighting for office buildings ("Lux"). The fact that there is so much power coming from the sun and shining into the library and lights are still being used is mind boggling. Every time a value was checked, it was after blinds had been opened since they are almost always closed during the day time.

Results

Table 1. Light Intensity in McKillop Library (units are in lumens per square meter)

Floor	By window min.	By window max.	Away from window min.	Away from window max.
Basement	--	--	500	700
First floor	700	2000*	530	650
Second floor	700	4300**	530	680
Third floor	650	20000***	530	690

Legend ~~>>

*at 6:00pm
**not in direct sun
*** direct sun

Discussion

Day lighting is one of the easiest ways to stop unnecessary use of lighting in a place. A case study done by the Lighting Research Center discusses the Harmony Library in Fort Collins, Colorado, which is completely lighted by the sun. Though created that way, it gives feedback from the library's visitors that the lighting from the sun is always comfortable and never too dark (Daylight Dividends: Case Study – Harmony Library). With this case study alone, we know that the sun does, in fact, produce enough light to comfortably

and efficiently light an entire library. However we know that it is not necessary to rebuild the library to fit these specs, we can do simple changes like leaving the shades open and arranging desks to give library users by sunlight instead of lamp light while the sun is in its best positions. According to an article on planetgreen.discovery.com, motion sensors are more efficient than just flipping the switch on and off, especially in low-traffic areas like bathrooms where people often forget to shut off the light, as well as managing the lighting over the archives which pretty much has little to no traffic compared to the rest of the library. Methods towards improving McKillop's energy output towards lighting could possibly include switching all incandescent light bulbs to compact fluorescent bulbs, investing in the installation of motion sensor lights and timers, and simply turning off some of the lights during the day. Simply turning these lights and all table lamps off during the day when there is sufficient sunlight shining through the windows could potentially decrease the energy put towards lighting 50%. Also, if McKillop library chose to make the small investment in motion sensor lights it could have incredible energy and money saving potential. Motion sensors range from approx. $50.00 to $100.00 and in a short amount of time would pay itself off in energy savings (Lower). Just last week I was in the library at 3:20 p.m. and every single ceiling light was on as well as all wall sconces and table lamps even at tables that were not in use. Excess energy put towards lighting in McKillop library could easily be reduced but only if the initiative is taken to do so.

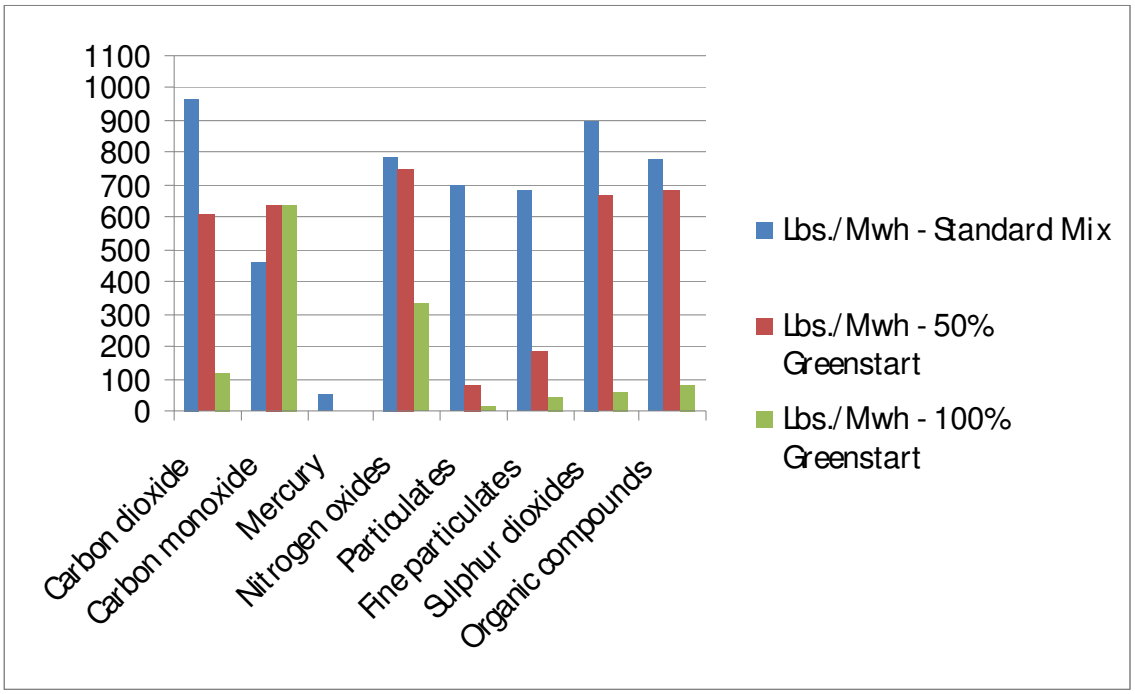
Overall Recommendations

There are many issues that can be addressed within the library when it comes to electricity. Switching to a GreenStart electricity source would be extremely beneficial. Offering two stages of either 50% GreenStart mix of solar, wind, hydroelectric and biomass power, or 100% GreenStart mix will change the impact that the library has entirely. Although a little most costly, it could save money for costly renovations and also secure the library's energy sources for decades to come as the Earth slowly runs out of fuels that we rely on today. We have calculated the difference between the Rhode Island Standard Mix power option and the 50% and 100% GreenStart Mixes (Table 2). In the table you will find the undeniable difference that only a relatively small amount of extra money can make on the environment.

Table 2. Environmental emission (Lbs/Mw) of standard mix and greenstart programs provided by National Grid.

Emission	**Lbs./Mwh - Standard Mix**	**Lbs./Mwh – 50% Greenstart**	**Lbs./Mwh – 100% Greenstart**

Carbon dioxide	**965.50**	**611.50**	**121.20**
Carbon monoxide	**459.50**	**638.70**	**637.60**
Mercury	**53.30**	**0.00**	**0.00**
Nitrogen oxides	**787.40**	**751.00**	**334.20**
Particulates	**702.30**	**85.10**	**16.50**
Fine particulates	**681.90**	**186.10**	**45.00**
Sulphur dioxides	**896.30**	**669.40**	**60.30**
Organic compounds	**777.10**	**687.50**	**79.20**



Currently the library is running on the "Standard" mix which primely composed of Coal, Natural Gas and Nuclear energy. These three energy sources release the highest amounts of emissions. By switching to the 50% Greenstart mix, or even the 100% Greenstart mix will switch from those big three sources to more abundant and renewable resources; for example, the 100% Greenstart mix operates on mostly Hydroelectric power at 76.4% reducing emissions from the standard mix this much reduces the carbon dioxide emission by 75%! (Greenstart Disclosure Label). I don't think it takes much of a question to see what package would put less stress on the environment. Whatever the choice, we must switch to at least 50% GreenStart Mix as part of the "green-modling" of McKillop Library or every other change will seem highly insignificant.

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